

## Appendix A

# The Electromagnetic Environment

EM energy is both a natural and manmade occurrence. This energy, in the form of EM radiation, is made up of oscillating electric and magnetic fields and is propagated at the speed of light. EM radiation is measured by the frequency of its wave pattern's repetition with a set unit of time. The standard term for the measurement of EM radiation is the hertz (Hz), the number of repetitions (cycles) per second. The term "electromagnetic spectrum" refers to the range of frequencies of EM radiation from zero to infinity. The spectrum is divided into 26 alphabetically designated bands.

## MILITARY ELECTROMAGNETIC SPECTRUM

A-1. Figure A-1 shows the principal military segment of the EM spectrum with the corresponding EW frequency bands and radar designations and why there is occasionally confusion when discussing frequency bands, which share names in different designation systems. The EME is the resulting product of the power and time distribution, in various frequency ranges, of the radiated or conducted EM emission levels that may be encountered by a military force, system, or platform when performing its assigned mission in its intended operational environment. The EME is the sum of—

- EM interference.
- EM pulse.
- Hazards of EM radiation to personnel, ordnance, and volatile materials.
- Natural phenomena effects of lightning and precipitation static (p-static).

A-2. P-static is created by charged precipitation particles that strike antennas and gradually charge the antenna, which ultimately discharges across the insulator, causing a burst of static.

## MILITARY OPERATIONS AND ELECTROMAGNETIC ENVIRONMENT

A-3. The impact of the EME upon the operational capability of military forces, equipment, systems, and platforms is referred to as EME effects. EME effects encompass all EM disciplines, including—

- EM compatibility (EMC) and EM interference (EMI).
- EP.
- Hazards of EM radiation to personnel, ordnance (HERO).
- Volatile materials such as fuels.

- Natural phenomena effects of lightning and p-static.

A-4. Equipment and systems which operate on the principles of electromagnetism are characterized by electromagnetic vulnerability which cause them to suffer a definite degradation (incapability to perform the designated mission).

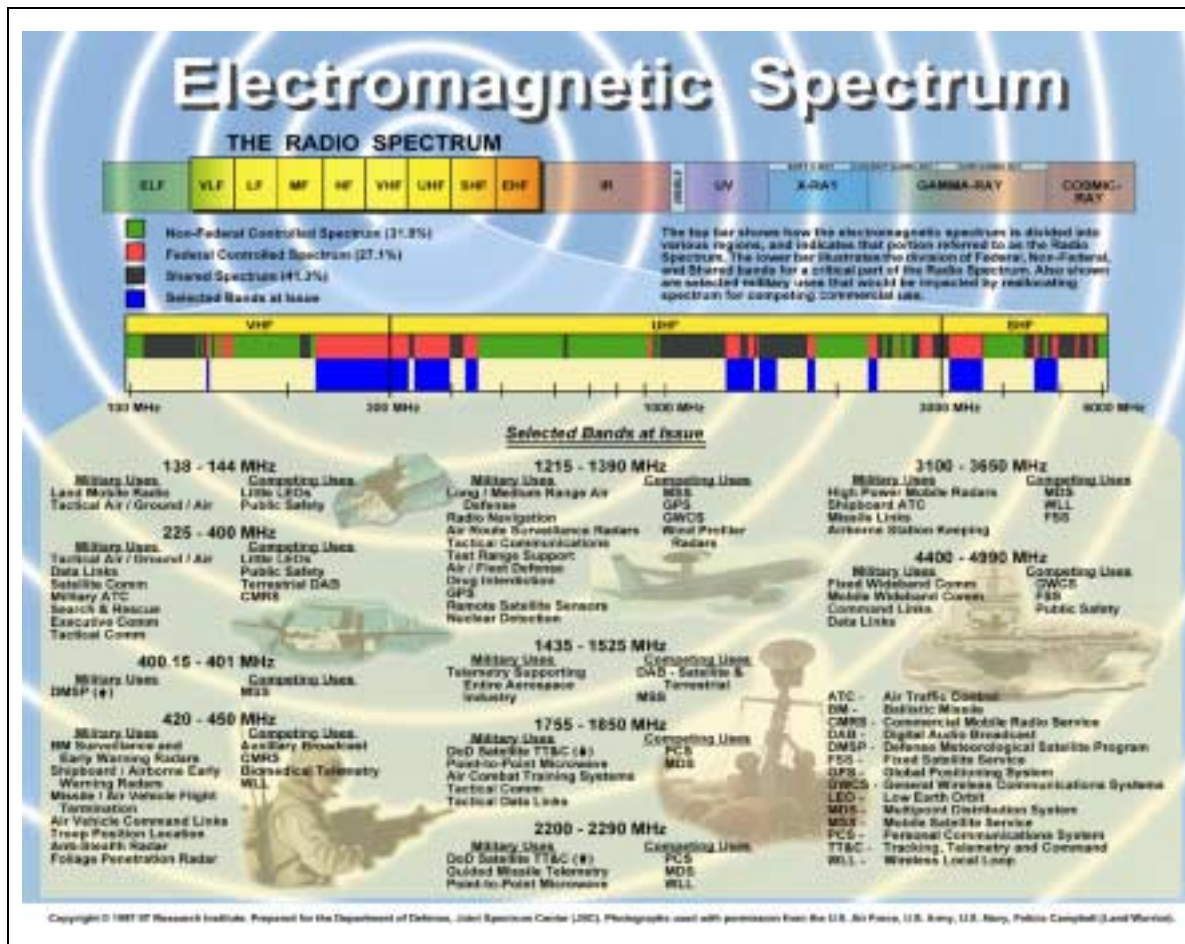


Figure A-1. Electromagnetic Spectrum

## DIRECTED ENERGY IN EW

A-5. DE includes actions taken to protect friendly equipment, facilities, and personnel and retain friendly use of the EM spectrum. Possible applications include lasers, RF weapons, and particle beam weapons. As the development of DEW evolves, TTP must also evolve to ensure their safe, effective employment. Although some DE applications will easily fit into traditional EW roles, others will not. For example, in EW terms—

- A laser designed to blind or disrupt optical sensors is ES.

- A laser-warning receiver designed to detect and analyze a laser signal is ES.
- A visor or goggle designed to filter out the harmful wavelength of laser light is EP.

A-6. The potential for the threat's use of destructive DE weapons and other destructive RF weapons is also growing. Intelligence assets must be tasked to collect information about this threat, and joint planning must include the development of operational procedures and COAs to mitigate the effects on these weapons.

## **PRINCIPAL ELECTRONIC WARFARE ACTIVITIES**

A-7. The principal activities used in EW have been developed over time to exploit the opportunities and vulnerabilities, which are inherent in the physics of EM energy. Although new equipment and new tactics continue to be developed, the physics of EM energy remains constant. This physical constant is the reason that the basic activities of EW remain effective despite changes in hardware and tactics. The principal activities used in EW follow.

### **ELECTROMAGNETIC COMPATIBILITY**

A-8. EMC is the ability of systems, equipment, and devices that use the EM spectrum to operate in their intended operational environments without suffering unacceptable degradation or causing unintentional degradation because of EM radiation or response. EMC involves the application of sound EM spectrum management:

- System, equipment, and device design configuration that ensure interference.
- Free operation.
- Clear concepts and doctrines that maximize operational effectiveness.

### **ELECTROMAGNETIC DECEPTION**

A-9. EM deception is the deliberate radiation, reradiation, alteration, suppression, absorption, denial, enhancement, or reflection of EM energy in a manner intended to convey misleading information to an enemy or to enemy EM-dependent weapons, thereby degrading or neutralizing the enemy's combat capability. Types of EM deception are discussed below.

#### **Manipulative EM Deception**

A-10. This type of deception involves actions to eliminate revealing or to convey misleading EM telltale indicators that may be used by hostile forces.

#### **Simulative EM Deception**

A-11. This type of deception involves actions to simulate friendly, notional, or actual capabilities to mislead hostile forces.

#### **Imitative EM Deception**

A-12. This type of deception introduces EM energy into enemy systems that imitates enemy emissions.

**EM Hardening**

A-13. EM hardening consists of actions taken to protect personnel, facilities, and/or equipment by filtering, attenuating, grounding, bonding, and/or shielding against undesirable effects of EM energy.

**EM Interference**

A-14. EMI is any EM disturbance that interrupts, obstructs, or otherwise degrades or limits the effective performance of electronics and electrical equipment. It can be induced intentionally, as in some forms of EW, or unintentionally, as a result of spurious emissions and responses, intermodulation products, and the like.

**EM Intrusion**

A-15. EM intrusion is the intentional insertion of EM energy into transmission paths in any manner, with the objective of deceiving operators or of causing confusion.

**EM Jamming**

A-16. EM jamming is the deliberate radiation, reradiation, or reflection of EM energy for the purpose of preventing or reducing an enemy's effective use of the EM spectrum, and with the intent of degrading or neutralizing the enemy's combat capability.

**Electromagnetic Pulse**

A-17. EMP is the EM radiation from a nuclear explosion caused by Compton-recoil electrons and photoelectrons from photons scattered in the materials of the nuclear device or in a surrounding medium. The resulting electric and magnetic fields may couple with electrical and electronic systems to produce damaging current and voltage surges. EMP may also be caused by nonnuclear means.

**Electronic Masking**

A-18. Electronic masking is the controlled radiation of EM energy on friendly frequencies in a manner to protect the emissions of friendly communications and electronic systems against enemy ES or SIGINT, without significantly degrading the operation of friendly systems.

**Electronic Probing**

A-19. Electronic probing is the intentional radiation designed to be introduced into the devices or systems of potential enemies for the purpose of learning the functions and operational capabilities of the devices or systems.

**Electronic Reconnaissance**

A-20. Electronic reconnaissance is the detection, identification, evaluation, and location of foreign EM radiations emanating from other than nuclear detonations or radioactive sources.

**Electronic Intelligence**

A-21. Electronic intelligence (ELINT) is the technical and geolocational intelligence derived from foreign noncommunications EM radiations emanating from other than nuclear detonations or radioactive sources.

**Electronics Security**

A-22. Electronics security (ELSEC) is the protection resulting from all measures designed to deny unauthorized persons information of value that might be derived from their interception and study of noncommunications EM radiations (for example, radar).

**EW Reprogramming**

A-23. EW reprogramming is the deliberate alteration or modification of EW or target sensing systems or the TTP that employ them, in response to validated changes in equipment, tactics, or the EME. These changes may be the result of deliberate actions on the part of friendly, adversary, or third parties; or they may be brought about by EMI or other inadvertent phenomena. The purpose of EW reprogramming is to maintain or enhance the effectiveness of EW and target sensing systems equipment. EW reprogramming includes changes to self-defense systems, offensive weapons systems, and intelligence collection systems.

**Emission Control**

A-24. Emission control (EMCON) is the selective and controlled use of EM, acoustic, or other emitters to optimize C<sup>2</sup> capabilities while minimizing for OPSEC detection by enemy sensors; mutual interference among friendly systems; and/or execution of a military deception plan.

**Spectrum Management**

A-25. Spectrum management involves planning, coordination, and managing joint use of the EM spectrum through operational, engineering, and administrative procedures, with the objective of enabling electronic systems to perform their functions in the intended environment without causing or suffering unacceptable interference.

**Wartime Reserve Modes**

A-26. Wartime reserve modes (WARMs) are characteristics and operating procedures of sensors, communications, navigation aids (NAVAIDs), threat recognition, weapons, and countermeasures systems that will contribute to military effectiveness if unknown to or misunderstood by opposing commanders before they are used, but could be exploited or neutralized if known in advance. WARMs are deliberately held in reserve for wartime or emergency use and seldom, if ever, applied or intercepted prior to such use.

**IEW Support**

A-27. Electronic forms of intelligence gathering (for example, SIGINT, measurement and signature intelligence [MASINT]) comprise a significant portion of the day-to-day activities of the intelligence community. The

distinction between intelligence and ES is determined by who tasks or controls the intelligence assets, what they are tasked to provide, and for what purpose they are tasked.

A-28. ES is achieved by intelligence collection, processing, and exploitation assets tasked or controlled by an operational commander. These assets are tasked to search for, intercept, identify, locate, and report sources of intentional or unintentional radiated EM energy.

A-29. The purpose of ES tasking is immediate threat recognition and other tactical actions such as threat avoidance, targeting, and homing. ES is intended to respond to an immediate operational requirement. However, the same assets and resources, which are tasked with ES, can also collect intelligence at the same time that meets other collection requirements. Intelligence collected for ES purposes normally are also processed by the appropriate parts of the intelligence community for further exploitation after the operational commander's ES requirements are met.